PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
MATTHEW S. RYSKOSKI

Serial No.: 10/021,676

Filed: December 12, 2001

For: METHOD AND APPARATUS FOR SCHEDULING PRODUCTION LOTS BASED ON LOT AND TOOL HEALTH METRICS

Group Art Unit: 2125

Examiner: ALBERT W. PALADINI

Atty. Dkt. No.: 2000.08330/SFD

#13

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CERTIFICATE OF TRANSMISSION 37 CFR 1.8(a)

I hereby certify that this correspondence is being facsimile transmitted to the United States Patent and Trademark Office, Fax No. (703) 746-7238 on January 15, 2004.

Scott F. Diring

AMENDED APPEAL BRIEF Letter

Sir:

Applicant hereby submits this amended Appeal Brief to the Board of Patent Appeals and Interferences in response to the final Office Action dated June 27, 2003 and the Examiner's Answer dated December 15, 2003. No fees are believed to be due in support of this Reply Brief. However, should any fees under 37 C.F.R. §§ 1.16 to 1.21 be required for any reason relating to the enclosed materials, the Commissioner is authorized to deduct said fees from Advanced Micro Devices, Inc. Deposit Account No. 01-0365//TT4500.

I. REAL PARTY IN INTEREST

The assignee of this application is Advanced Micro Devices, Inc.

II. RELATED APPEALS AND INTERFERENCES

No other appeals or interference known to appellant will directly affect, be directly affected by, or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-41 have been rejected and are the subject of this appeal.

IV. STATUS OF AMENDMENTS

All previous amendments have been entered.

V. SUMMARY OF INVENTION

Independent claims 1, 21, and 41 include the general feature of scheduling items based on determined item health metrics in view of determined tool health metrics. Claims 2-8 and 22-28 include the additional feature of measuring characteristics of a plurality of manufactured items in the process flow and estimating the item health metrics for the plurality of manufactured items based on the measured characteristics. Claims 14-16 and 34-36 include the additional feature of generating a tool state trace related to the processing of a selected manufactured item in a selected tool, comparing the tool state trace to a tool health model associated with the selected tool, and generating the tool health metric based on the comparison between the tool state trace and the tool health model. Claims 17-20, 37-40 include the additional feature of ranking tools and items based on their respective health metrics and scheduling based on the rankings. In claims 17 and 37, the ranking is performed using a threshold comparison.

VI. ISSUES

A. Are claims 1-41 obvious under 35 U.S.C. § 103(a) over United States Patent No. 5,519,605 (Nulman)?

VII. GROUPING OF CLAIMS

Claims 1, 9-13, 21, 29-34, and 41 may be considered as a first group that stands or falls together;

Claims 2-8 and 22-28 may be considered as a second group that stands or falls together;

Claims 14-16 and 34-36 may be considered as a third group that stands or falls together; and

Claims 17-20, 37-40 may be considered as a fourth group that stands or falls together.

VIII. ARGUMENT

A. Claims 1-41 are not obvious under 35 U.S.C. § 103(a) over United States Patent No. 5,519,605 (Nulman).

Independent claims 1, 21, and 41 include the general feature of scheduling items based on determined item health metrics in view of determined tool health metrics. The item health metrics are useful for ascertaining the quality of the items, while the tool health metrics are useful for determining the performance of the tools. In one example, as set forth in claim 19, items with higher relative health may be processed in tools

having higher relative health to maintain that level of health, thereby increasing the likelihood that the item will have high performance characteristics when completed.

The Office Action asserts that Nulman teaches these features. To the contrary Nulman does not teach scheduling based on a comparison between item quality and tool quality. Nulman looks at SPC information to identify tool problems (*i.e.*, stop production) or to set control limits for the devices. Nulman does not schedule based on tool and item quality (*i.e.*, selecting which tools to use). Nulman schedules based on tool availability, not based on a measure of quality for the items being processed and a measure of quality for the tools. Nulman looks at items such as power load management and spare parts requirements for scheduling. Nulman also uses SPC information related to item quality for process control, not as an input for the scheduling process. Accordingly, Nulman does not teach or suggest "scheduling the manufactured items for processing in the tools based on the item health metrics in view of the tool health metrics."

Inherently tool health relates to a relative measurement of a tool's efficacy. Simply determining if a tool is available does not provide a tool health measure. The claims include the feature of scheduling based on item health and tool health. Even if assuming, *arguendo*, that tool availability is a measure of tool health, it would be pointless to employ item health if the only tool health measure was a binary 1 or 0 value. The item health would then become irrelevant. The purpose of determining tool health and scheduling based on item and tool health is to distinguish between available tools. The construction proffered by the Office Action defeats this purpose and negates the determining of item health element of the claim. Hence, Nulman teaches away from

Applicant's invention. Accordingly, claims 1, 21, 41, and all claims depending therefrom are allowable. Applicant respectfully requests the rejection of these claims be reversed.

The dependent claims also include other features, such as particular parameters used to determine item health (*e.g.*, claims 2-8, 22-28), techniques for determining tool health (*e.g.*, claims 14-16, 34-36), and particular scheduling operations based on the comparison between item and tool health that are not taught or suggested by Nulman (*e.g.*, claims 17-20, 37-40). Item and tool health cannot be meaningfully compared where the only tool information is availability. The Office Action does not include any specific citations to Nulman regarding these features to demonstrate how they are obvious. Applicant asserts that these claims are themselves allowable over Nulman. It is the Office's burden to establish *prima facie* that the claimed invention is obvious. By failing to point out with particularity how Nulman teaches the features of these claims, the Office has failed to meets its burden. Accordingly, the dependent claims are themselves patentable for these additional reasons. Applicants respectfully request the rejection of these claims be reversed.

B. Conclusion

Applicants contend that the prior art does not anticipate or obviate any of the pending claims. Applicants respectfully requests that the rejections of all of the claims be reversed.

Respectfully submitted,

Assistant Commissioner for Patents
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Date: January 15, 2004

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APPENDIX

Claims involved in this appeal:

1. (Original) A method for scheduling production flow, comprising:

processing a plurality of manufactured items in a process flow;

determining item health metrics for at least a subset of the plurality of manufactured items;

determining tool health metrics for a plurality of tools in the process flow; and

scheduling the manufactured items for processing in the tools based on the item health metrics and the tool health metrics.

2. (Original) The method of claim 1, wherein determining the item health metrics further comprises:

measuring characteristics of a plurality of manufactured items in the process flow;

estimating the item health metrics for the plurality of manufactured items based on the measured characteristics.

3. (Original) The method of claim 2, wherein estimating the item health metrics further comprises estimating at least one of a grade parameter and a yield parameter.

4. (Original) The method of claim 2, wherein measuring the characteristics comprises measuring a physical characteristic of the manufactured items.

5. (Original) The method of claim 4, wherein the manufactured items comprise semiconductor devices, and measuring the physical characteristic comprises measuring at least one of a transistor gate critical dimension, a process layer thickness, a particle contamination count, and a transistor active region dimension.

6. (Original) The method of claim 2, wherein measuring the characteristics comprises measuring at least one of an implant dose and energy, and an anneal temperature and time

7. (Original) The method of claim 2, wherein measuring the characteristics comprises measuring an electrical characteristic of the manufactured items.

8. (Original) The method of claim 7, wherein the manufactured items comprise semiconductor devices, and measuring the electrical characteristic comprises measuring at least one of a transistor effective channel length, a drive current, an insulating layer dielectric constant, a transistor overlap capacitance, a regional material resistivity, a transistor threshold voltage, an n-channel to p-channel drive current ratio, an off-state transistor leakage current, and electrical charge carrier mobility measurement, and an oscillator test circuit frequency.

9. (Original) The method of claim 2, further comprising periodically measuring the characteristics of the manufactured items and updating the item health metrics as the manufactured items progress through the process flow.

10. (Original) The method of claim 1, wherein processing the plurality of manufactured items comprises processing at least one of a plurality of microprocessors, a plurality of memory devices, a plurality of digital signal processors, and a plurality of application specific integrated circuits.

11. (Original) The method of claim 1, wherein the plurality of manufactured items are grouped into lots, and the determining the item health metric further comprises determining a lot health metric.

12. (Original) The method of claim 11, wherein scheduling the manufactured items for processing in the tools further comprises grouping lots with similar lot health metrics for processing in a selected tool.

13. (Original) The method of claim 1, wherein scheduling the manufactured items for processing in the tools further comprises grouping items with similar item health metrics for processing in a selected tool.

14. (Original) The method of claim 1, wherein determining the tool health metrics further comprises:

generating a tool state trace related to the processing of a selected manufactured item in a selected tool;

comparing the tool state trace to a tool health model associated with the selected tool; and

generating the tool health metric based on the comparison between the tool state trace and the tool health model.

15. (Original) The method of claim 14, wherein generating the tool state trace further comprises measuring a parameter of the selected tool during the processing of the selected manufactured item.

16. (Original) The method of claim 15, wherein comparing the tool state trace to the tool health model further comprises predicting a parameter of the tool during the processing of the selected manufactured item and comparing the measured parameter to the predicted parameter.

17. (Original) The method of claim 1, wherein scheduling the manufactured items for processing in the tools further comprises:

comparing the item health metric associated with a selected manufactured item to a predetermined threshold;

determining a high performing tool based on the tool health metrics; and

scheduling the selected manufactured item in the high performing tool responsive to the item health metric exceeding the predetermine threshold.

18. (Original) The method of claim 1, wherein scheduling the manufactured items for processing in the tools further comprises:

ranking the tools in order of performance based on the tool health metrics;

ranking the manufactured items in order of health based on the item health metrics; and

scheduling the manufactured items in the tools based on the performance rankings and the health rankings.

19. (Original) The method of claim 18, wherein scheduling the manufactured items further comprises giving preference to the manufactured items with relatively higher item health metrics to tools with relatively higher tool health metrics.

20. (Original) The method of claim 18, wherein ranking the manufactured items further comprises ranking each manufactured item based on its item health metric and at least one of a priority associated with the manufactured item and an age associated with the manufactured item.

21. (Original) A manufacturing system, comprising:

a plurality of tools for processing a plurality of manufactured items in a process flow;

an item health monitor configured to determine item health metrics for at least a subset of the plurality of manufactured items;

a tool health monitor configured to determine tool health metrics for at least a subset of the plurality of tools; and

a scheduling server configured to schedule the manufactured items for processing in the tools based on the item health metrics and the tool health metrics.

22. (Original) The system of claim 21, wherein the item health monitor is further configured to access measurements of a characteristic of a plurality of manufactured items in the process flow and estimate the item health metrics for the plurality of manufactured items based on the measurements.

23. (Original) The system of claim 22, wherein the item health monitor is further configured to determine the item health metrics based on at least one of a grade parameter and a yield parameter.

24. (Original) The system of claim 22, wherein the characteristic further comprises a physical characteristic of the manufactured items.

25. (Original) The system of claim 24, wherein the manufactured items comprise semiconductor devices, and the physical characteristic comprises at least one of a transistor gate critical dimension, a process layer thickness, a particle contamination count, and a transistor active region dimension.

26. (Original) The system of claim 22, wherein the characteristic comprises at least one of an implant dose and energy, and an anneal temperature and time

27. (Original) The system of claim 22, wherein the characteristic comprises an electrical characteristic of the manufactured items.

28. (Original) The system of claim 27, wherein the manufactured items comprise semiconductor devices, and the electrical characteristic comprises at least one of a transistor effective channel length, a drive current, an insulating layer dielectric constant, a transistor overlap capacitance, a regional material resistivity, a transistor threshold voltage, an n-channel to p-channel drive current ratio, an off-state transistor leakage current, and electrical charge carrier mobility measurement, and an oscillator test circuit frequency.

29. (Original) The system of claim 22, wherein the item health monitor is further configured to periodically access measurements of the characteristics of the manufactured items and update the item health metrics as the manufactured items progress through the process flow.

30. (Original) The system of claim 21, wherein the plurality of manufactured items comprise at least one of a plurality of microprocessors, a plurality of memory devices, a plurality of digital signal processors, and a plurality of application specific integrated circuits.

31. (Original) The system of claim 21, wherein the plurality of manufactured items are grouped into lots, and the item health metric further comprises a lot health metric.

32. (Original) The system of claim 31, wherein the scheduling server is further configured to group lots with similar lot health metrics for processing in a selected tool.

33. (Original) The system of claim 21, wherein the scheduling server is further configured to group items with similar item health metrics for processing in a selected tool.

34. (Original) The system of claim 21, wherein the tool health monitor is further configured to access a tool state trace related to the processing of a selected manufactured item in a selected tool, compare the tool state trace to a tool health model associated with the selected tool, and generate the tool health metric based on the comparison between the tool state trace and the tool health model.

35. (Original) The system of claim 34, wherein the tool state trace further comprises a parameter of the selected tool measured during the processing of the selected manufactured item.

36. (Original) The system of claim 35, the tool health monitor is further configured to predict a parameter of the tool during the processing of the selected manufactured item and compare the measured parameter to the predicted parameter.

37. (Original) The system of claim 21, wherein the scheduling server if further configured to compare the item health metric associated with a selected manufactured item to a predetermined threshold, determine a high performing tool based on the tool health metrics, and schedule the selected manufactured item in the high performing tool responsive to the item health metric exceeding the predetermine threshold.

38. (Original) The system of claim 21, wherein the scheduling server is further configured to rank the tools in order of performance based on the tool health metrics, rank the manufactured items in order of health based on the item health metrics, and schedule the manufactured items in the tools based on the performance rankings and the health rankings.

39. (Original) The system of claim 38, wherein the scheduling server is further configured to give preference to the manufactured items with relatively higher item health metrics to tools with relatively higher tool health metrics.

40. (Original) The method of claim 38, wherein the scheduling server is further configured to rank each manufactured item based on its item health metric and at least one of a priority associated with the manufactured item and an age associated with the manufactured item.

41. (Original) A manufacturing system, comprising:

means for processing a plurality of manufactured items in a process flow;

means for determining item health metrics for at least a subset of the plurality of manufactured items;

means for determining tool health metrics for a plurality of tools in the process flow; and

means for scheduling the manufactured items for processing in the tools based on the item health metrics and the tool health metrics.